

DIY

Worthwhile projects you can build on your own



20-30-40 end-fed SOTA antenna

Because I like to both hike and radio, I'm a fan of POTA (parks on the air) and SOTA (summits on the air), so I've been looking for a lightweight, portable, and easy-to-mount multi-band QRP antenna. While gathering info for [this very UVARC Shack issue](#), I happened upon [the story of Brad Bylund WA6MM](#), who was rescued from an otherwise snowy grave while he was attempting a SOTA activation. I was looking at [his QRZ bio](#), as I usually do for our article subjects, and discovered his plans for a SOTA antenna that works for him, and that seemed to fit my needs.

His design is a cross between a multi-band trap antenna, an end-fed inverted-L antenna, and a sloper. And because it only supports the arguably most popular SOTA bands (40-, 30-, and 20-meters), it's not only much shorter than an 80-meter antenna, but does not require as much height over ground. This antenna does not require a counterpoise or other ground for performance, yet the unun is designed to mitigate the [common-mode current](#) it might generate.

The plans calls for an 81:1 unun and two tank circuit traps, so the construction is a little more involved than I would have liked for a simple DIY article. But, hey, that's the adventure, right? For simplicity and to keep this project small and lightweight, I've decided to use sheets of ABS instead of enclosures for the three coil circuits. Let's dig in and see what it's going to take.

Parts list

One toroidal [Fair-Rite T50-43 ferrite core](#)

Two toroidal [T50-2 powdered iron cores](#)

32 feet [18 AWG speaker wire pair](#)

One [8" x 12" x 1/8" ABS sheet](#)

Ten [18 AWG #8 stud ring terminals](#)

Five #8 [screws](#), [wing nuts](#), [washers](#), [lock washers](#)

One [dogbone insulator](#)

One [rubber washer](#)

One [SO-239 bulkhead connector](#)

Three [150 pF 500 V silver mica capacitors](#)

One spool [22 AWG magnet wire](#)

One [19-foot telescoping fiberglass pole](#)

One [18 AWG #4 stud ring terminal](#)

Four each M3 [screws](#), [split washers](#), [nuts](#)

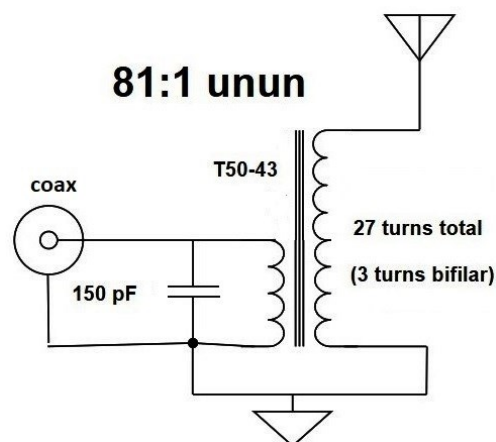
[Zip ties](#), [heat shrink tubing](#)

One 250-foot roll [nylon string](#)

Matching unit "unun" assembly

The diagram to the right shows what we're trying to accomplish with the unun. The purposes of this design are to a) maximize common-mode current reduction, b) minimize losses, while c) maintaining a 50-ohm impedance transformation on the transceiver side of the unun d) for a wide range of frequencies e) on 20 watts of transmit power.

Cut a 2" x 2½" piece of the ABS sheet for the unun foundation, where we'll attach the bulkhead connector, the toroidal transformer, the capacitor, and the antenna connection. Drill a 9/16" hole in the ABS





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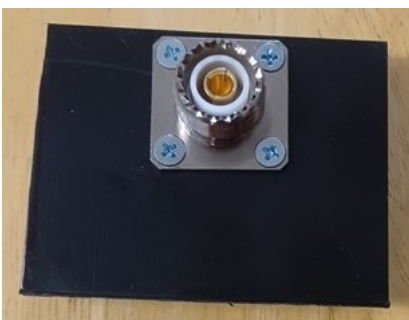
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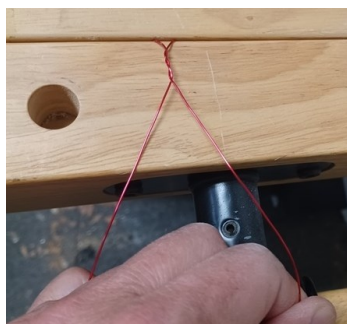
sheet $\frac{1}{2}$ " from one edge. Place the solder cup end of the SO-239 bulkhead into the $\frac{9}{16}$ " hole on the outside of the ABS sheet, and using the four mounting holes of the bulkhead as a template, drill a $\frac{1}{8}$ " hole for each mounting hole. Assemble the bulkhead onto the enclosure using the M3-0.5 mm hardware.



The three ABS pieces



Cut the 22 AWG magnet wire into one 7-inch wire and one 41-inch wire. Lay the two wires together in parallel, with one of the ends of one even with one of the ends of the other. While pinching about an inch of the wires in a vise, pull-twist the two wires about 45 degrees from each other *tightly* into a 7-inch-long helix. The number of twists in the helix is not nearly as important as how tightly they're wound together, and so doesn't matter much.



This is known as a *bifilar* ("two-filament") pair. Place the junction of the long and short wires on the side of the toroid, and *tightly* wrap **three turns** of the pair over the top and around one toroid arc. Continue wrapping the longer wire *tightly* around the toroid arc for **26 more turns**, leaving about four inches extra on each end. Use a sanding block (or plain, fine-grit sandpaper) to sand off the insulation of about a half inch off the four magnet wire ends.

Solder together the twisted bifilar pair end of the magnet wires and one leg of a 150 pF capac-

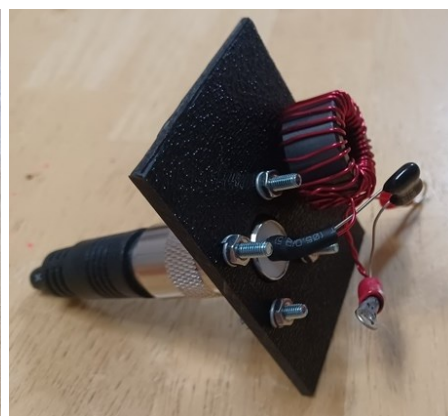
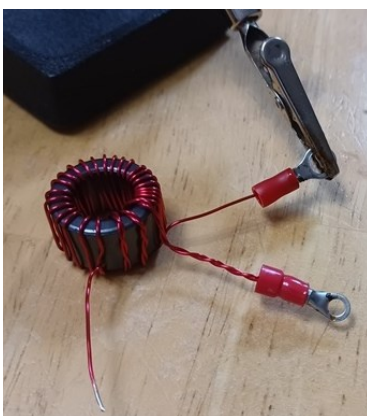
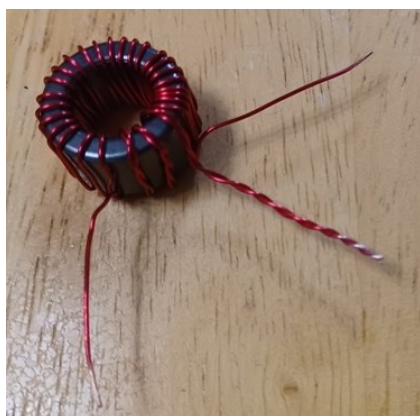


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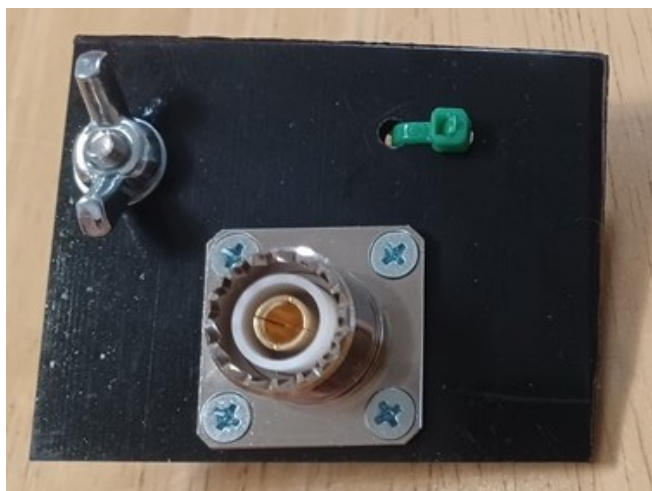
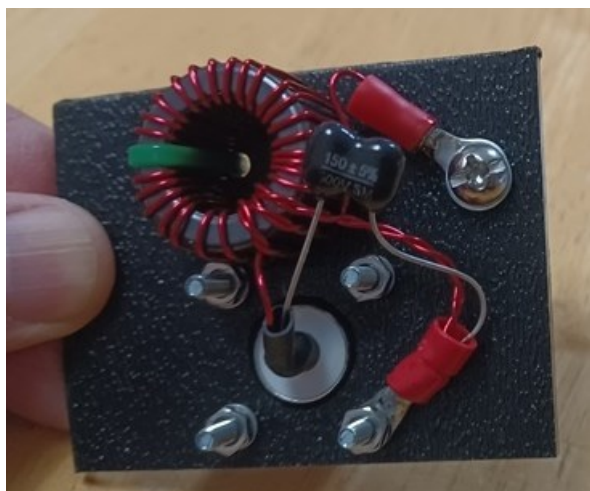
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itor to a #4 stud ring terminal. Plug a PL-259 connector into the SO-239 bulkhead, for a heat sink. If you don't plug in a connector, soldering the cup in the rear of the bulkhead can get hot enough to melt the bulkhead dielectric, especially if you're using a low-wattage (under 60 watts) soldering iron. Solder the other end of the short magnet wire and the other leg of the same capacitor to the center solder cup of the SO-239 bulkhead connector. Bolt the #4 stud ring terminal to one of the M3-0.5 screws of the bulkhead.



Drill a 3/16" hole near one end of the ABS sheet, and insert a #8 screw, washer, and wing nut. Solder the remaining end of the long magnet wire to a #8 stud ring terminal, and install the ring terminal onto the #8 screw. Secure the coil onto the ABS sheet with a zip tie, if you'd like, and the unun construction is complete.



Trap assembly

Cut a 2" x 2" piece of the ABS sheet for the **20-meter trap** foundation, and drill two 3/16" holes in the sheet. Cut a 10-inch length of the 22 AWG magnet wire and tightly wrap **13 turns**



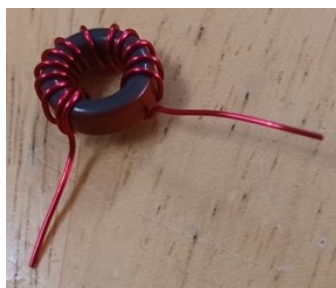
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of the wire evenly around a T50-2 toroid. Sand the wire ends and solder each end to a leg of a 150 pF capacitor and a #8 stud ring terminal. Install the ring terminals to the ABS sheet using the #8 hardware. Secure the coil onto the ABS sheet with a zip tie, if you like.

Cut a 2" x 2" piece of the ABS sheet for the **30-meter trap** foundation, and drill two 3/16" holes in the sheet. Cut a 13-inch length of the 22 AWG magnet wire and tightly wrap **18 turns** of the wire evenly around a T50-2 toroid. Sand the wire ends and solder each end to a leg of a 150 pF capacitor and a #8 stud ring terminal. Install the ring terminals to the ABS sheet using the #8 hardware. Secure the coil onto the ABS sheet with a zip tie, if you like.



Wire element assembly

Rip the entire length of the 18 AWG speaker wire in two. Cut three lengths of the speaker wire as **31 feet 2 inches**, **11 feet 4 inches**, and **13 feet 5 inches**. Strip all the wires. Optionally, drill strain relief holes in the ABS. Terminate both ends of the first two by soldering them to #8 stud ring terminals. Terminate only one end of the 13-foot-5-inch wire with a ring terminal. Tie the other end onto a dogbone insulator.



Attach the ring terminal of one end of the 31-foot-2-inch wire to the unun, and the other end of the wire to one end of the 20-meter trap. Attach one end of the 11-foot-4-inch wire to the other end of the 20-meter trap, and the other end of the wire to one end of the 30-meter trap. Attach the ring terminal of the 13-foot-5-inch wire to the other end of the 30-meter trap, and the antenna construction is complete.



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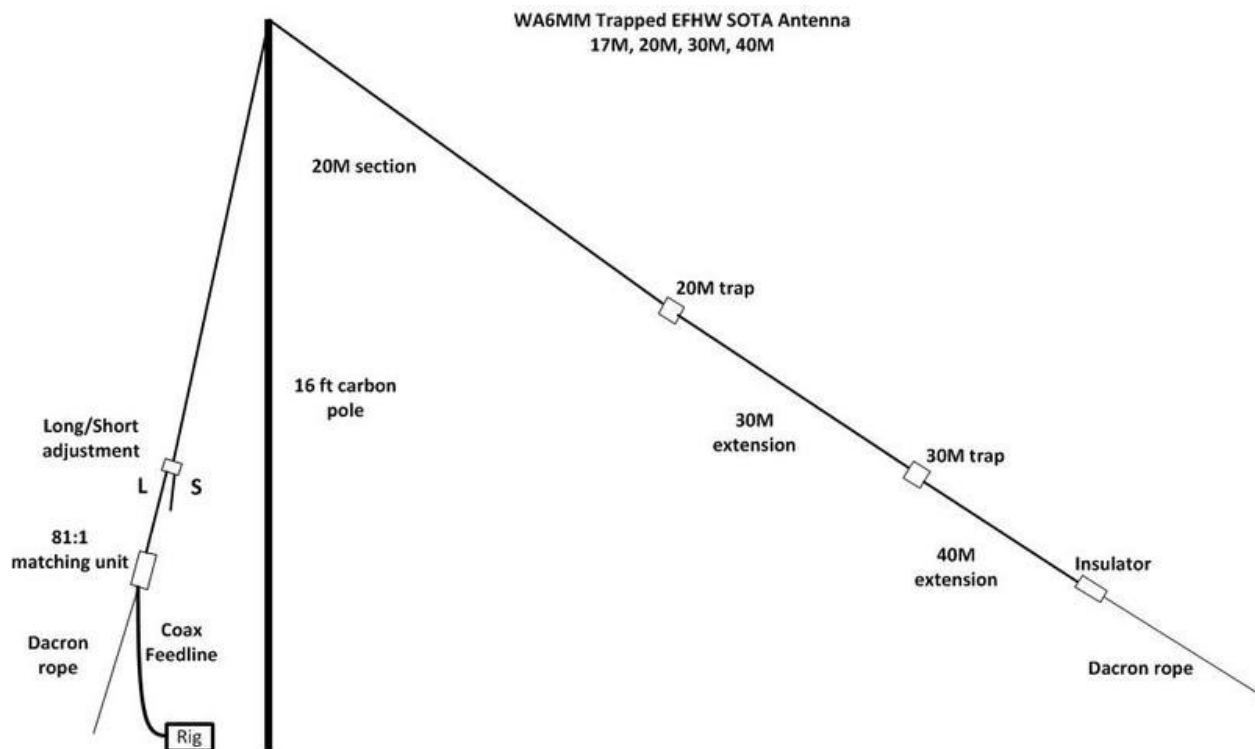
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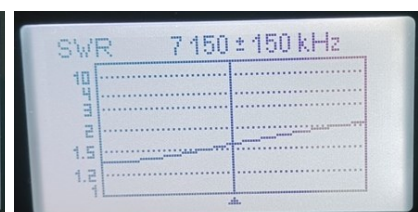
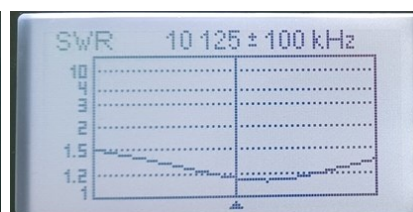
Testing the antenna

Attach the end of the fiberglass pole to the 31-foot-2-inch wire loosely, to allow the antenna element plenty of play for height adjustment. Attach two 25-foot lengths of nylon string to two rubber garden hose washers and slip the washer pair over the fiberglass pole about 13-ish feet up from the bottom for guy wires. Extend the fiberglass pole all the way, and secure the two nylon guy wires to some immobile items, like rocks or bricks. Attach some paracord to the unused end of the dogbone insulator and to the end of the unun opposite the wire.

The following illustration shows how the antenna installation should roughly appear when it's ready for operation (I chose not to use the long / short adjustment shown):



Here are some SWR measurements with the antenna fully installed as it should be, and away from any conductive objects, except the dirt:





DIY, continued

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As you can see, the antenna tunes up well on 20, 30 and 40 meters. The above drawing also shows its ability to handle 17 meters, but it was out of range for the internal tuner of my rig.



Summary

The 20-30-40 SOTA antenna is lightweight, portable, and fairly easy to build and set up. The two traps make it a three-band antenna. A ground connection is not necessary for performance. The 81:1 unun helps match the wire to the feed line, but also helps mitigate the common-mode current that's created from the lack of counterpoise.

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